Space Weather Technical Forecast

Issued on Sunday, 14 July 2024 at 01:20 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further M-Class flares expected (R1-R2 Blackouts)

Analysis of Space Weather Activity over past 24 hours

Solar Activity: High with seven M-class flares. The majority of these, including an M5.3 at 13/1272 UTC and an M5.0 at 13/2301 UTC were from AR3738. This is the largest and most active of the ten regions currently on the Earth-facing disc. While a largely open region, it has a number of dark umbrae, including the two large positive leader spots. The region also developed a weak but magnetically complex delta-configuration to the northwest of its main leader spot, with further small and weak delta spots evident across the region. AR3744, AR3743 and AR3745, all in the eastern disc, while smaller and relatively simple also saw some emergence of further spots. AR3751, AR3750 and AR749 all rotated onto the southeast disc, and were numbered.

Despite the number of solar flares, no Earth-directed CMEs have been observed. However the M5.0 at 13/2301 UTC has the potential to have produced a CME, and this will be assessed once imagery is available.

Solar Wind / Geomagnetic Activity: Slow wind conditions dominated the solar wind environment. Observed speeds at ACE persisted at background 300-350 km/s, while the density remained below or near average. Total Interplanetary Magnetic Field, Bt, was weak, below 7nT, with the north-south component, Bz, weak and variable, between -4nT and +5nT. Phi angle was largely negative (towards the Sun). Geomagnetic activity was Quiet (Kp 1).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at Background. High energy electron flux (greater than 2MeV) observed by GOES16 was at Background. The 24-hour fluence was below Active, with a gradually declining trend and 1.48e6 integrated pfu observed at 14/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Further M-class flares are expected, with a slight chance of X-class flares, most likely from AR3738.

Solar Wind /Geomagnetic Activity: There are no Earth-directed CMEs. Initial slow wind conditions are expected to be followed by a slight enhancement due to the onset of the fast winds from CH52 on day 1 (14 Jul). Any enhancement then easing day 2 (15 Jul) onward. Mainly Quiet geomagnetic activity expected, with isolated Unsettled intervals. And fast wind enhancement on day 1 (14 Jul) will bring a likelihood of an Unsettled to Active spell and a slight chance of G1 Minor Storm intervals.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at Background levels, but with a chance of rising in response to any notable flares, mainly from AR3737. This would typically bring a slight chance of reaching the S1 Minor Storm threshold. However, the recent M5.0 flare brings a slightly enhanced chance of this occurring day 1-2 (14-15 Jul). High energy Electron flux is expected to persist at background at first, with a chance of rising to Moderate or perhaps briefly High later in the period in response to any fast wind enhancement on day 1 (14 Jul). The associated 24 hr fluence is expected to persist below the

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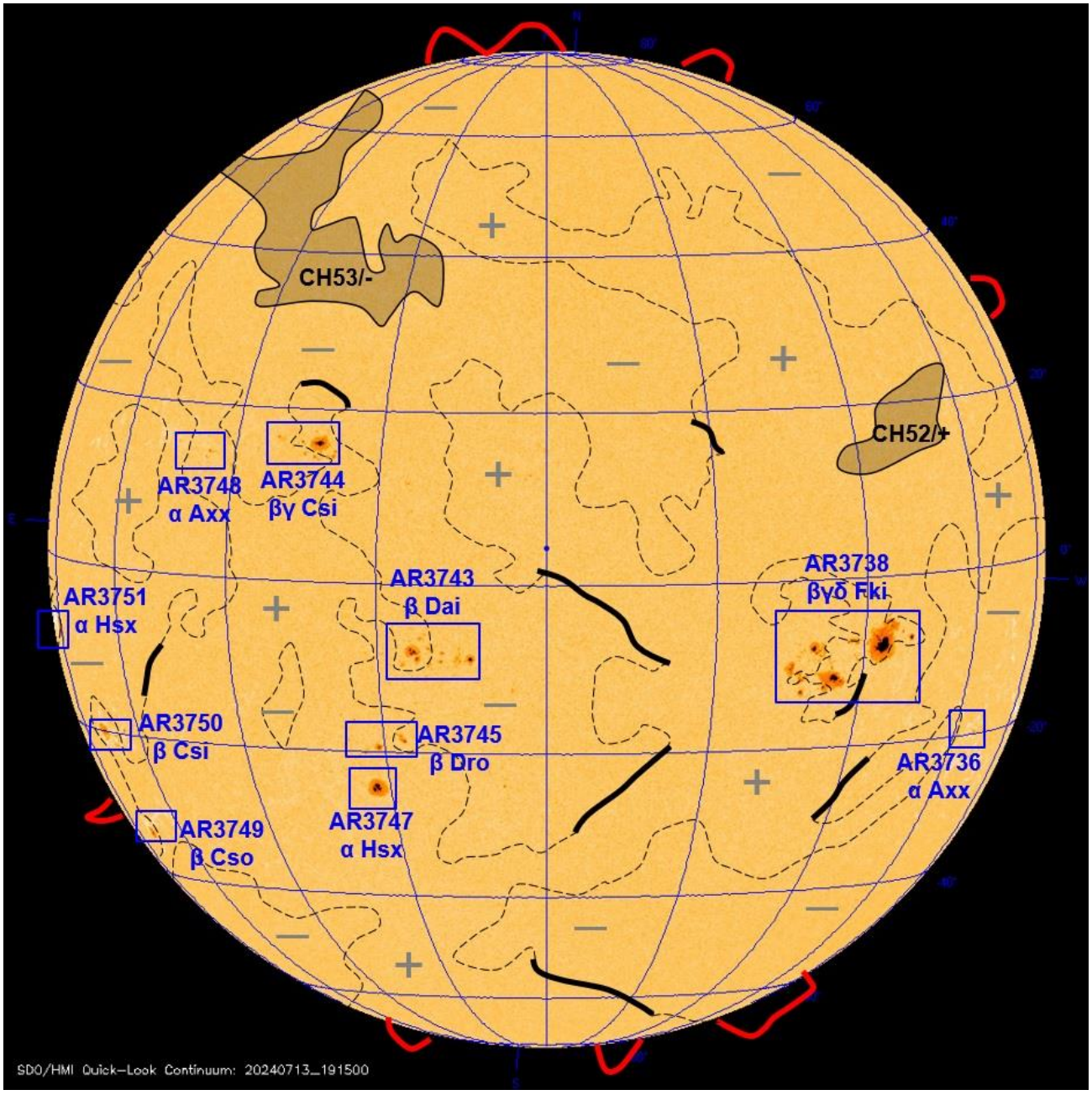
Active threshold (1e8 integrated pfu).

Figure 1. Solar Analysis Valid 13/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

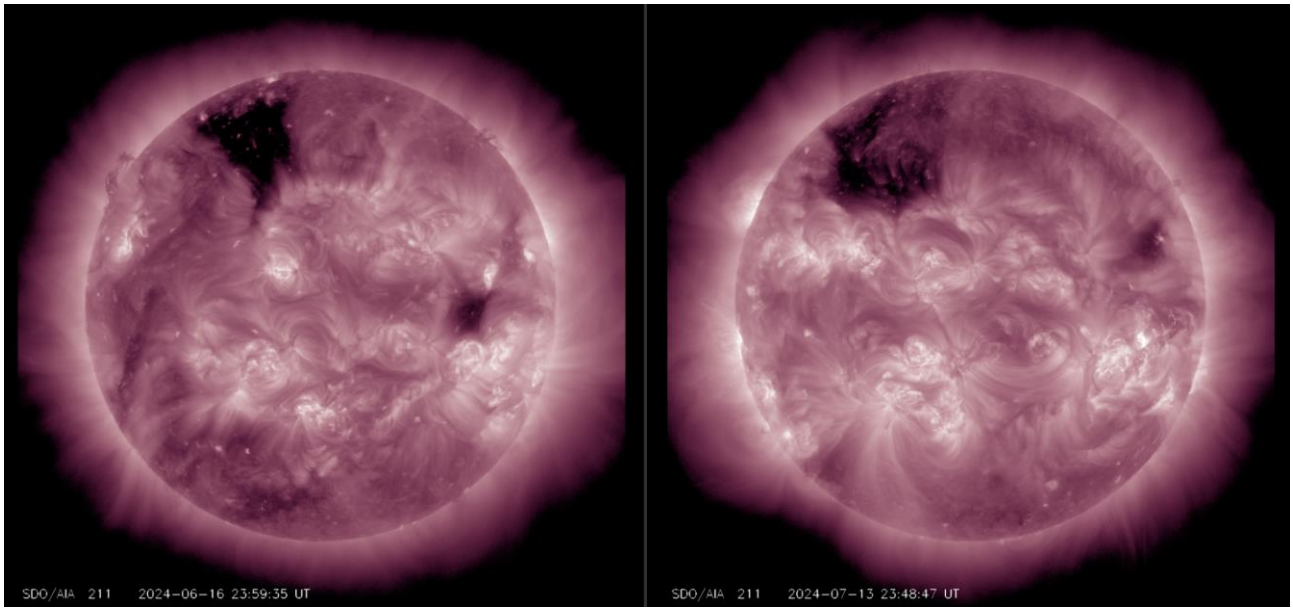
There are no Earth-directed CMEs.

The anticipated enhancement from the arrival of CH52 fast wind has yet to occur, suggesting any increase to solar winds is likely to be weaker than originally anticipated, perhaps rising to around 450-500km/s later on day 1 (14 Jul). This remains low confidence however, with MOSWOC Enlil currently providing poor guidance due to over-estimating the enhancement from a pair of coronal holes on the southwestern disc. This enhancement was not observed. This will bring a likelihood of Unsettled to Active intervals later day 1 (14 Jul) with a chance of G1 Minor Storm intervals.

Any fast wind enhancement will then ease day 2 onward (15 Jul) with mainly Quiet to Unsettled geomagnetic activity following.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: SDO aia211 (left: last rotation, right: current). Persistence of CH visible, but displaced to the northwest. Large region in northeast, not impacting on this forecast period.



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Radio Blackouts - X-Ray Flares:

Activity is expected to be mainly Moderate, with further M-class flares, and a slight chance X-class flares. The more intense flares are most likely from AR3738, but there is a potential for some flare activity from across the ten regions currently on the disc.

AR3738, located in the southwest, is a relatively large region, comprised of two large positive spots, with smaller negative trailers, along with other smaller intermediate and surrounding spots. This region also contains a couple of weak delta-spots, one of which is likely the source of the recent instability to the northwest of the main leader. This is where the majority of recent flare activity from this region has originated. While the overall structure of the spot is fairly open, there are signs of increasing complexity within its magnetic canopy with brightening on some SDO imagery.

The other regions, while smaller, are also of note. This includes AR3744, which has developed a ring of opposite polarity spots to its south with a likely increase in shear across its magnetic field lines, and AR3745 which has shown some growth since its recent LP M 1.8 flare. Some slow flux emergence also continues in AR3743. The newer regions near the E-limb, AR3749/3750/3751, but also further regions over the limb have some potential for flaring, with bright looping evident on SDO imagery, but these will need to move to a less oblique viewing angle for an accurate assessment.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	75	70	60
Very Active	R3 to R5 X Class	No	20	20	15	10

Figure 3a: GOES 16/18 X-ray Flares

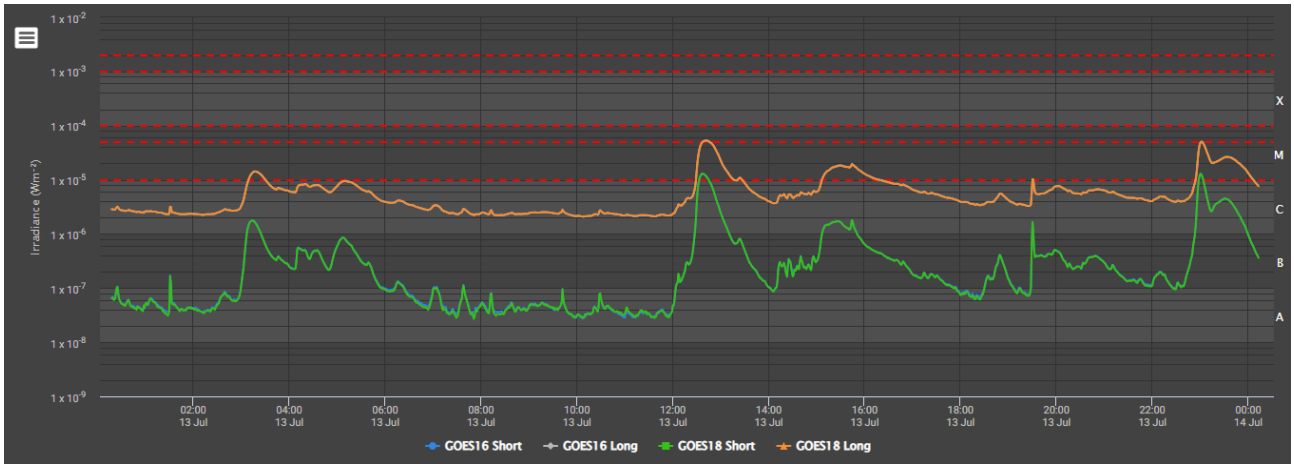

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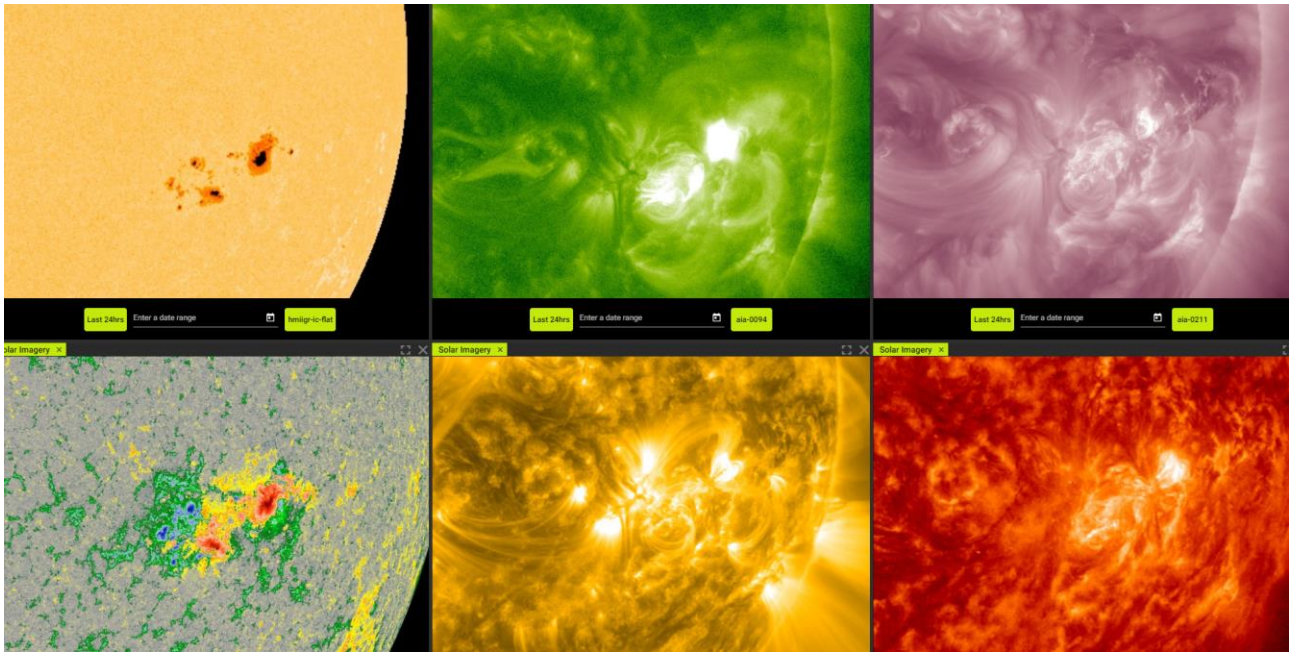
Figure 3b: SDO imagery of AR3738



Solar Radiation Storms - (High Energy Protons):

High energy proton flux at GOES18 is at Background. It is most likely to remain at background, but with a slight chance of exceeding the S1/Minor radiation storm threshold should any significant flares occur, these perhaps most likely from AR3738.

The M5.0 flare at 13/2301 UTC, from AR3738 brings a slightly enhanced chance of reaching this level on day 1-2 (14-15 Jul).

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	25	20	15	15
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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High Energy Electrons Event (≥ 2MeV):

High energy electron flux, as observed by GOES-16, is currently at Background, but is likely to see a modest increase later in the period due to the expected fast wind enhancement from CH52/+. This is expected to occur through day 1 (14 Jul), with any fast wind influence then easing day 2 (15 Jul onward). Moderate high energy electron flux is then likely, with a slight chance of reaching High later in the period.

The associated 24 hour fluence is expected to remain below the Active threshold however, with only a very slight chance of rising above from late day 2 onward. REFM is currently providing good guidance, at least for day 1 and into day 2 (Jul 14-15). Confidence in the REFM forecast then falls due to any potential fast wind enhancement.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	5	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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